ORIGINAL RESEARCH

Dietary Self-Care in Adolescents with Type 1 Diabetes: Report from the Juvenile Diabetes and Dietary Study

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ABSTRACT

OBJECTIVE: This study had 3 aims: a) to examine the relationships between metabolic control, self-perceptions of dietary self-care, types of motivation and parental autonomy support toward dietary self-care in adolescents with type 1 diabetes; b) to explore gender differences in the above variables; and c) to verify the extent to which types of motivation and autonomy support from parents predict metabolic control and dietary self-care.

METHODS: A consecutive series of 289 adolescent patients with type 1 diabetes, aged 11 to 17 years, was recruited from 2 pediatric diabetes outpatient clinics in the province of Québec between January and December 2003.

RESULTS: Metabolic control was found to be suboptimal, with mean glycated hemoglobin levels of 8.5% (SD 1.6). Dietary recommendations were generally carried out for autonomous reasons: that is, for the satisfaction and pleasure of eating healthfully (mean 3.62, SD 1.0, range 1–5) or because these activities were valued or considered important (mean 4.35, SD 0.8, range 1–5). Results also showed that the more adolescents performed these activities because they felt controlled or were amotivated, the more they presented poor dietary self-care and metabolic control. Similarly, regression analysis revealed that controlled regulation (ß 0.13, p<0.05) and amotivation (ß 0.13, p<0.05) toward dietary self-care predicted poor metabolic control. Analyses revealed no gender differences.

CONCLUSION: Minimizing sources of pressure to pursue dietary self-care could be a promising avenue for improving dietary self-care in adolescents with type 1 diabetes.

KEYWORDS: adolescents, dietary self-care, metabolic control, motivation, type 1 diabetes

RÉSUMÉ

OBJECTIFS : Cette étude avait trois objectifs : a) examiner les liens entre le contrôle métabolique, les perceptions d'autogestion alimentaire, les types de motivation et le soutien à l'autonomie de la part des parents en matière d'observance du plan alimentaire chez les adolescents atteints de diabète de type 1; b) examiner les différences entre les sexes pour ce qui est des variables ci-dessus; et c) déterminer dans quelle mesure les types de motivation et le soutien à l'autonomie de la part des parents permettent de prédire le contrôle métabolique et l'observance du plan alimentaire.

MÉTHODES : Une série consécutive de 289 adolescents de 11 à 17 ans a été recrutée au Québec dans deux services de soins externes pour enfants atteints de diabète de type 1 entre janvier et décembre 2003.

RÉSULTATS : Les résultats ont montré que le contrôle métabolique était sous-optimal, le taux moyen d'hémoglobine glycosylée étant évalué à 8,5 % (écart type [ET] : 1,6). Les recommandations alimentaires étaient en général suivies pour des raisons autonomes, c'est-à-dire pour la satisfaction et le plaisir de manger sainement (moyenne de 3,62, ET de 1,0, écart de 1 à 5), ou parce que ces recommandations étaient considérées importantes (moyenne de 4,35, ET de 0,8, écart de 1 à 5). Les résultats ont aussi montré que plus les adolescents suivaient les recommandations parce qu'ils se sentaient contrôlés ou amotivés, plus leur observance et leur contrôle métabolique étaient médiocres. De la même façon, l'analyse de régression a indiqué que la régulation contrôlée (ß 0,13, p < 0,05) et l'amotivation (ß 0,13, p < 0,05) en matière d'autogestion alimentaire étaient des prédicteurs de contrôle métabolique médiocre. Les analyses n'ont pas révélé de différences entre les sexes.

CONCLUSION : Réduire au minimum les sources de pression en ce qui a trait aux comportements alimentaires pour–rait

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être prometteur pour l'amélioration de l'autogestion alimentaire chez les adolescents atteints de diabète de type 1.

MOTS CLÉS : adolescents, autogestion du plan alimentaire, contrôle métabolique, motivation, diabète de type 1

INTRODUCTION

To keep blood glucose levels within a normal range, young patients with type 1 diabetes must perform a complex set of self-care activities, including insulin replacement and following a healthy diet as recommended in Health Canada's *Eating Well with Canada's Food Guide* (1). Specifically, this involves consuming a wide variety of foods from each of the 4 food groups that suit young patients' nutritional needs, eating habits, lifestyle, ability and interest, and matching food consumption with adequate insulin administration (2). However, data suggest that dietary self-care in adolescence is difficult for many young patients, with adherence levels as low as 20 to 50% (3). Moreover, the literature shows that metabolic control in adolescents is often unsatisfactory, with most having blood glucose levels higher than the optimal range (4-6). Given that early diabetes control reduces the onset and progression of complications (5), it is important to know the extent to which adolescents with type 1 diabetes follow their dietary plan and succeed in controlling their glycemic levels. Specifically, examining the reasons why some adolescents do or do not follow their recommended dietary plan is important to our understanding of poor metabolic control in adolescence.

According to self-determination theory (SDT) (7), developing a sense of autonomy, where action comes from the self, is critical to the initiation, direction and maintenance of human behaviour. Within SDT, the concept of autonomy relates to a sense of volition, as opposed to one of being controlled. SDT proposes that the extent to which a social milieu allows one to experience feelings of autonomy will determine one's quality of motivation. As such, a large body of research based on SDT focuses on how external behaviours (such as prescribed dietary self-care activities) can be integrated into one's value sets with the help of significant others (such as parents) and how this integration can translate into optimal motivation and well-being. While no SDT studies have yet been carried out on dietary self-care in adolescents living with type 1 diabetes, research in adults suggests that patients who perceive to be supported in their dietary self-care efforts ultimately present the highest quality of motivation, as well as better dietary self-care and metabolic control (8,9).

The primary goals of this study were as follows: a) to document and examine the relationships between metabolic control, self-perceptions of dietary self-care, types of motivation (intrinsic, identified, controlled, amotivation) and parental autonomy support toward dietary self-care in adolescents with type 1 diabetes; b) to explore gender differences in the above variables; and c) to verify the extent to which types of motivation and autonomy support from parents contribute to the explanation of dietary self-care and metabolic control. Before addressing these goals, we portrayed the demographic and lifestyle attributes of adolescents with type 1 diabetes, as well as their recall of other important diabetes self-care recommendations and practices, such as for insulin injections and blood glucose readings. This study is the first to pursue these goals among a sample of Canadian adolescents with type 1 diabetes.

METHODS

Procedure and participants

Data were obtained from the first wave of the Juvenile Diabetes and Dietary Study, a 3-year longitudinal study of dietary self-care in families of adolescents with type 1 diabetes (10). Participants were recruited at the outpatient clinics of 2 major pediatric diabetes centres in the province of Quebec. Rather than relying on a convenience sample of patients, efforts were invested in the identification of all patients with type 1 diabetes aged 11 to 17 years and who attended the 2 outpatient clinics from January to December 2003. Consecutive series of participants were recruited using 2 methods: either an interviewer initially contacted the adolescents and their parents to invite them to complete a questionnaire at the child's next scheduled appointment, or adolescents and parents were approached by the treating physician during consultation and then referred to a trained research assistant, who was present in the clinic's waiting room. Informed consent was obtained from all participants. Adolescents completed a self-report questionnaire on dietary self-care and motivation for dietary self-care, while the accompanying parent answered a background questionnaire that included demographic data (age, family structure). Both questionnaires were completed individually. Adolescents also agreed to participate in a 10-minute phone interview 7 days later to answer additional questions about their diabetes history (year of diagnosis, complications and general diabetes self-care recommendations and practices). Adolescents received $10 each for their participation. The study protocol received ethical approval from the research ethics committees at Université Laval and the Mother and Child University Hospital Centres of Sainte-Justine and Université Laval.

Measures

The medical charts of participating adolescents were consulted by the treating physician to retrieve data on metabolic control prior to the beginning of the study. These data were abstracted using a pen-and-paper system. Metabolic control was assessed using glycated hemoglobin (A1C) level. Higher

A1C levels reflect poor blood glucose control. The current recommended goal for A1C in adolescents with type 1 diabetes is <7.0%, which is considered to be good metabolic control (1).

Dietary self-care over the previous 7 days was assessed by a single item of the diet subscale of the Summary of Diabetes Self-Care Activities scale from Toobert and Glasgow (11), a scale developed for use with adults, but adapted and used with adolescents with type 1 diabetes in previous studies (12-14). This item asked adolescents to evaluate how often they had followed their recommended dietary program over the last 7 days. It was scored on a 5-level descriptor scale ranging from 1 (never) to 5 (always). Higher scores indicate better dietary self-care.

Motivations for managing dietary self-care activities was assessed using the Dietary Self-Care Motivation Scale for Adolescents with Diabetes (DSMS-AD) (15). The DSMS-AD consists of 12 items representing 4 motivational constructs that reflect different types of motivation, which can be situated along a continuum of autonomy. Each item represents a possible answer to the question "Why do you follow your dietary self-care activities?" and was scored on a 5-point scale ranging from 1 (do not agree at all) to 5 (completely agree). Based on SDT (7), the DSMS-AD assesses intrinsic regulation (3 items), the most autonomous form of motivated behaviour; in this case, managing dietary self-care for the satisfaction and pleasure of eating healthfully (e.g. "Because I found it fun to prepare meals and snacks that are good for my health"; Cronbach value of 0.75). Next is identified regulation (3 items), a relatively autonomous motivational construct because it relates to activities that are accepted by oneself, judged important and valuable for one's health, but not interesting in themselves (e.g. "Because I want to remain healthy as long as possible"; Cronbach value of 0.83). Further along the continuum is controlled regulation (3 items), which underlies dietary self-care behaviours that are performed to avoid feelings of guilt or shame, or due to the demands, treats or rewards of an external agent (e.g. "Because my doctor asks me to"; Cronbach value of 0.72). Finally, at the lower end of the continuum lies amotivation, which represents the least autonomous form of motivated behaviour (3 items) and involves a lack of intention or motivation (e.g. "I don't know what I'm getting out of dieting"; Cronbach value of 0.79).

Perceived autonomy support from parents was assessed by a modified version of the Perception of Parents Scale (16). The original scale comprised 21 items for mothers and 21 for fathers. To obtain a measure assessing the interpersonal style of both parents, mothers' and fathers' items were merged into a single scale. Three items were then judged redundant and removed (e.g. "My parents try to tell me how to run my life"; "My parents aren't very sensitive to many of my needs";

"My parents are often disapproving and unaccepting of me"). The remaining 18 items were adapted to diabetes-related situations. The subscale included supportiveness items such as "My parents seem to know how I feel about my diabetes"; involvement items such as "My parents find time to talk with me about my diabetes"; and warmth items such as "My parents accept me and like me as I am." Items were scored on a 7-point scale ranging from 1 (not at all true) to 7 (absolutely true). Cronbach's alpha for this sample was 0.90.

Statistical analyses

Means and standard deviations were used for continuous variables, and categorical variables were described using frequency statistics. Unpaired Student's t-tests were used to compare adolescent boys and girls on some demographic variables, health characteristics, age, diabetes duration, A1C and number of medical conditions related to diabetes. Pearson' correlation coefficients were calculated to determine the degree of association among types of motivations (intrinsic, identified, controlled and amotivation), dietary self-care, parental support and A1C. Linear regression analyses using stepwise variable selection were conducted to verify the contribution of intrinsic regulation, identified regulation, controlled regulation and amotivation in the prediction of both dietary self-care (first regression analysis) and A1C (second regression analysis). SPSS version 11.5 (SPSS Inc. Chicago, Illinois) was used for all analyses. Two-tailed p values of <0.05 were considered statistically significant.

RESULTS

Preliminary analysis

The demographic and lifestyle characteristics of participants are presented in Table 1. In total, 289 consecutive series of adolescents participated in this study (133 girls, 46%). There were no significant differences between boys and girls with respect to the number of medical complications related to diabetes, diabetes duration or age. Factors related to adolescents' general self-care recommendations and practices are presented in Table 2. The mean number of glucose readings per day was 3.6 (SD 0.7), significantly lower than the mean number of recommended glucose readings per day (3.9±0.4; t [260]=–7.224, p<0.001). As for insulin injections, almost all adolescents reported that they followed medical recommendations. Of the total sample, 61% injected insulin 3 times a day, 38% injected 4 or more times a day and 1% injected twice a day.

Main analyses

Mean A1C was 8.5% (SD 1.6), with no significant differences between boys and girls. Target A1C (<7%) was achieved in only 46 (16%) adolescents (24 boys, 52%); 151 (52%) had A1C levels between 7.0 and 9.0% (84 boys, 56%); and

Table 1. Characteristics of participants (N=289)

Characteristic	Value
Mean age of adolescent, y±SD (range)	13.9±1.5 (11–17)
Mean age at diabetes diagnosis, y±SD (range)	8.2±3.7 (1–16)
Mean duration of diabetes, y±SD (range)	5.6±3.8 (0–15.5)
Complications from diabetes Yes No	 26 (10) 232 (90)
Sex of parent Female Male Guardian other than parent	 221 (78) 53 (19) 11 (3)
Mean age of parent, y±SD (range)	42.7±4.9 (32–57)
Family structure 2-parent family (married or not) Single-parent family	 214 (75) 71 (25)
Number of siblings None 1 or 2 ≥3	 35 (12) 217 (75) 37 (13)
Smoking status of adolescent Yes No	 21 (7) 266 (93)
Alcohol consumption status of adolescent Yes No	 88 (31) 198 (69)
Education of parent High school College or professional degree Graduate studies	 101 (37) 91 (33) 84 (30)
Employment of parent Full-time job Part-time job Unemployed	 42 (15) 190 (69) 45 (16)
Net annual income of parent ≤$29 999 $30 000–$39 999 $40 000–$49 999 $50 000–$59 999 ≥$60 000	 120 (46) 50 (19) 32 (12) 22 (9) 35 (14)

Numbers are n (%) unless otherwise indicated.
Numerical discrepancies reflect missing values.

Table 2. Treatment recommendations and self-care behaviours of adolescents with type 1 diabetes (N=289)

Characteristic	Value
Mean A1C, %±SD (range)	8.5±1.6 (5.3–14.2)
Number of hypoglycemic episodes in previous month, mean±SD (range)	8.9±7.7 (0–40)
Insulin pump therapy Yes No	 7 (2) 280 (98)
Number of insulin injections per day, mean±SD (range) 2 3 ≥4	3.4±0.5 (2–6) 3 (1) 162 (61) 100 (38)
Adolescents' report of adherence to insulin recommendations Yes No	 279 (98) 5 (2)
Number of blood glucose tests per day, mean±SD (range) 1–2 3 ≥4	3.6±0.7 (1–5) 17 (6) 75 (29) 169 (65)
Number of recommended blood glucose tests per day, mean±SD (range) 2 3 ≥4	3.9±0.4 (2–4) 5 (2) 27 (10) 244 (88)
Physical activity counselling by healthcare practitioners during the course of diabetes Yes No	 32 (11) 255 (89)
Practicing a sport or exercising on a regular basis Yes No	 182 (64) 103 (36)
Dietary counselling at diagnosis Yes No Too young to remember	 180 (65) 7 (3) 87 (32)
Number of appointments with a dietitian in the previous year, mean±SD (range) 1 2 ≥3	2.9±1.4 (1–6) 33 (12) 106 (39) 131 (49)
Person mostly responsible for meal preparation at home Both parents, equally Mother Father	 49 (19) 193 (73) 22 (8)

Numbers are n (%) unless otherwise indicated.
A1C = glycated hemoglobin

92 (32%) had A1C levels >9% (48 boys, 52%). In terms of adolescents' perceptions of dietary self-care, 51% reported they had followed their dietary program *sometimes* or *never* during the previous week. In contrast, 49% reported they had followed their dietary recommendations *usually* or *always*. No gender differences were found in reports of dietary self-care (t [286]=0.10, p=0.92).

For dietary self-care motivation, mean scores were higher on the more autonomous forms of motivation, namely identified and intrinsic regulations. Mean identified regulation in adolescents was 4.35 (SD 0.8), whereas mean intrinsic regulation for dietary self-care was 3.62 (SD 1.0). For lower autonomous motivation, the mean score for controlled regulation was 2.86 (SD 1.0) and for amotivation was 1.88 (SD 1.0). Independent t-tests revealed no gender differences in type of motivation, indicating that girls and boys reported similar levels of intrinsic regulation, identified

regulation, controlled regulation and amotivation toward dietary self-care.

Correlation coefficients between type of motivation and dietary self-care followed an ordered pattern, where positive correlations were observed between dietary self-care and intrinsic regulation (r=0.17, p≤0.01) and identified regulation (r=0.13, p≤0.05), and negative correlations with controlled regulation (r=–0.21, p≤0.01) and amotivation (r=–0.22, p≤0.01). As for the relationships between dietary self-care motivation and parental autonomy support, results revealed that the more adolescents perceived that their parents were autonomy supportive of their dietary self-care initiatives, the more they regulated self-care recommendations for identified reasons (r=0.46, p≤0.01) and the more they engaged in these activities for intrinsic reasons (r=0.43, p≤0.01). In contrast, perceptions of parental support were related negatively to motivations that were non-autonomous in nature, such as controlled regulation (r=–0.15, p≤0.05) and amotivation (r=–0.36, p≤0.01). Interestingly, A1C levels were associated positively with controlled motivation (r=0.16, p≤0.01) and amotivation (r=0.16, p≤0.01), meaning that metabolic control was worst with non-autonomous types of motivation. As for the relationship between metabolic control and dietary self-care, results indicated that better dietary self-care was associated with better metabolic control (r=–0.18, p≤0.01).

Regression analysis revealed that intrinsic regulation (ß=0.36; p<0.001), controlled regulation (ß=–0.15; p<0.01) and amotivation (ß=–0.17; p<0.01) were significant predictors of dietary self-care, accounting for 23% of variance. As for metabolic control, controlled regulation (ß=0.13; p<0.05) and amotivation (ß=0.13; p<0.05) were the only significant predictors, accounting for 4% of variance.

DISCUSSION

The present study aimed to document dietary self-care and motivation in adolescents with type 1 diabetes. Along with demographic and lifestyle information, diabetes self-care recommendations, practices and metabolic control were documented in a consecutive series of adolescents with type 1 diabetes. Results showed that adolescents performed up to 3 or more glycemic readings and insulin injections per day. Few had received physical activity counselling at diagnosis, but the majority were physically active on a regular basis. Dietary counselling was given to most adolescents at diagnosis and was a continuing priority, as a good proportion of adolescents consulted with a dietitian several times a year. Nonetheless, overall metabolic control was suboptimal in this sample, with mean A1C values of 8.5% (SD 1.6). More precisely, only 16% of the adolescents in this sample had A1C values <7.0%, the threshold above which the risk of diabetes complica-

tions is known to rise steeply (5). In line with the results of other studies in pediatric populations (6,17), our findings correspond with the well-documented phenomenon of deterioration in metabolic control during the teenage years (18). Given the importance of dietary self-care to metabolic control (19), this study also aimed to document the extent to which adolescents succeeded in following their recommended dietary program. Results showed that, on average, adolescents perceived they had *sometimes* succeeded in following their dietary self-care program in the previous 7 days. This result concurs with the current diabetes adherence literature, which reports dietary adherence rates of approximately 40% in pediatric and adult populations (3).

Our findings have practical implications for the management of type 1 diabetes in adolescents. More efforts should be devoted to educating adolescents and their families about the importance of effectively managing dietary self-care activities. In contrast to insulin and glycemic recommendations, dietary self-care recommendations are more subjective. Thus, some adolescents may think they follow their dietary recommendations, when in fact they are under- or overestimating the carbohydrate contents of foods, resulting in poor metabolic control (20). However, growing evidence suggests knowledge alone does not translate into dietary improvement (21) and addressing patients' own perceptions about self-care is necessary to improve diabetes outcomes and quality of life (22).

Based on SDT (7), the reasons for engaging in dietary self-care activities were also investigated. Motives for dietary self-care were evaluated as autonomous, with higher mean scores on intrinsic and identified regulations. This means that dietary self-care recommendations were perceived as being performed largely in congruence with adolescents' personal values and goals (identified regulation) or out of pleasure (intrinsic regulation). Levels of controlled regulation were also noted, meaning that pressure from oneself ("Because I would feel ashamed if I didn't") or others ("Because my doctor asks me to") were relatively important motives for dietary self-care practices.

SDT suggests that, compared to less autonomous forms of regulation (controlled regulation and amotivation), the more autonomous regulations (intrinsic and identified regulations) are linked to more beneficial outcomes such as effective care, healthy eating and metabolic control (8,9,23). Although adolescents in this study reported higher autonomous motivations toward dietary self-care, this did not translate into adequate metabolic control. That is, regression analyses show that the only significant predictors of metabolic control were the less autonomous forms of motivation, namely controlled regulation and amotivation. It is, however, known that deterioration in diabetes control at adolescence

is also based on biological factors (i.e. pubertal insensitivity to insulin). Therefore, promoting autonomous motivation in adolescents with diabetes could be a continuing priority so that adolescents can remain engaged in their dietary self-care program and not become discouraged when A1C results do not match their self-care efforts. Further supporting this idea is the finding that intrinsic regulation, the most autonomous form of motivation, was found to be a significant predictor of dietary self-care in this study. Nonetheless, additional studies are required to replicate the present findings so as to confirm the relationship among types of motivation, metabolic control and dietary self-care.

According to SDT, when contextual agents are autonomy-supportive, patients tend to become more autonomous, and consequently experience greater choice and volition in their self-care behaviours (7). Autonomy-supportive practices involve acknowledging patients' perspectives and providing them with meaningful information and choices while supporting their self-care initiatives. Equally important for autonomy support would be minimizing coercive measures that pressure patients to behave involuntarily, such as being forced to adopt recommended dietary self-care practices. Because type 1 diabetes is a life-threatening condition, it is probable that parents use both autonomy-supportive and controlling actions to motivate their children to eat properly. For instance, Anderson and Coyne (24) outlined a process called "miscarried helping," which occurs when parents' well-intentioned efforts to help and motivate their children can thwart diabetes self-care because these actions are perceived as intrusive, excessive or inappropriate rather than supportive. Important here is the way adolescents perceive the actions of parents toward their dietary self-care efforts. Parents may believe that they adequately support their adolescents' choices and values about dietary self-care, but adolescents may, in fact, perceive their parents as being nagging and controlling. Such discrepancy in perceptions suggests that parents and adolescents should openly discuss their feelings and needs relating to dietary self-care. By addressing these issues, parents could adjust the way they support their adolescents' behaviours and in reaction to this, adolescents could potentially express better motivation (higher intrinsic regulation and lower controlled regulation and amotivation) as well as better dietary self-care.

In the self-determination theory literature, a growing number of studies conducted in adults with diabetes indicate that patients who perceive greater autonomy support have greater autonomous motivation and ultimately present better dietary self-care and metabolic control than patients who feel pressured to comply with dietary recommendations (9,25). In light our study findings, which suggest that the more adolescents perceived their parents to be supportive, the more autonomous and the less controlled they were

about their dietary self-care, interventions should aim to encourage parents to be less controlling. Ultimately, such interventions could diminish levels of less autonomous forms of motivation (controlled regulation and amotivation), which was associated with poorer dietary self-care and metabolic control in this study.

Strengths and limitations

This study has several limitations, each with implications for future research. Although the aim of this study was to document diabetes control and self-care in adolescents with type 1 diabetes, our sample may not be representative of the current general population. Adolescents were recruited in 2003 from 2 pediatric diabetes clinics in the province of Quebec, and very few were treated with insulin pump therapy (2%), a technology that closely mimics physiological insulin secretion upon carbohydrate load and consequently reduces the variability of patients' blood glucose levels. Because insulin pump therapy is now more widespread in Canada, future studies should examine dietary self-care in adolescent pump users. Moreover, in response to the growing costs of diabetes care and its complications in Canada, efforts should be made to gather more information about diabetes self-care in other provinces and territories. Nonetheless, because data from this study came from a consecutive series of patients, we believe that our results are representative of the adolescents served by our pediatric diabetes clinics. Another limitation is that we relied largely on self-reported measures, which can produce common method variance. We tried to minimize this problem by selecting self-reported measures that were formulated in different terms and by using different scale ranges. Future research could use information from other sources, such as motivations for dietary self-care as reported by parents and healthcare professionals. Finally, an additional study limitation is the lack of anthropometric data. Other studies should investigate whether adolescents' motivation and dietary self-care differ according to body mass index.

Notwithstanding these concerns, our findings contribute to the existing research on adolescents with type 1 diabetes. This study documents diabetes care in a consecutive series of adolescents with type 1 diabetes. Given the actual need to improve national diabetes surveillance systems in cohorts of patients with type 1 diabetes, our results have provided valuable information about the general self-care recommendations, practices and difficulties that adolescents face every day. Most importantly, our results have brought to light the importance of studying types of motivation and parental support for improving young patients' dietary self-care and metabolic control at adolescence. Finally, the finding of poor metabolic control in this study, as well as its association with poor dietary self-care, strongly supports

the relevance of improving nutritional education in order to promote healthy eating in adolescents with diabetes and minimize the risks of diabetes morbidity and mortality in this population.

ACKNOWLEDGMENTS

AUTHOR DISCLOSURES

AUTHOR CONTRIBUTIONS

SA participated in the data collection, data analysis and interpretation, and in drafting the manuscript. CS participated in the study design, supervision of the data collection, and the critical revision of the manuscript. FG participated in the review of the data and the manuscript. AN participated in the review of the manuscript. Funding was secured by CS, FG, and AN.

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